

UNIT I POWER PLANT

Lecture Hour 1: *INTRODUCTION*

Heat engine is a machine for converting heat, developed by burning fuel into useful work. It can be said that heat engine is equipment which generates thermal energy and transforms it into mechanical energy.

CLASSIFICATION OF HEAT ENGINES

1. Based on combustion of fuel:

- (i) External combustion engine
- (ii) Internal combustion engine.

External combustion engine

Here, the working medium, the steam, is generated in a boiler, located outside the engine and allowed in to the cylinder to operate the piston to do mechanical work.

Internal combustion engine

In internal combustion engine, the combustion of fuel takes place inside the engine cylinder and heat is generated within the cylinder. This heat is added to the air inside the cylinder and thus the pressure of the air is increased tremendously. This high pressure air moves the piston which rotates the crank shaft and thus mechanical work is done

2. Based on fuel used

1. Diesel engine 2. Petrol engine 3. Gas engine

Diesel engine – Diesel is used as fuel

Petrol engine – Petrol is used as fuel

Gas engines – propane, butane or methane gases are used

3. Based ignition of fuel

- 1. Spark ignition engine (Carburetor type engines)
- 2. Compression ignition engine (injector type engines)

Spark ignition engine – a mixture of air and fuel is drawn in to the engine cylinder. Ignition of fuel is done by using a spark plug. The spark plug produces a spark and ignites the air- fuel mixture. Such combustion is called constant volume combustion (C.V.C.).

Compression ignition engine – In compression ignition engines air is compressed in to the engine cylinder,. Due to this the temperature of the compressed air rises to 700-900 C. At this stage diesel is sprayed in to the cylinder in fine particles. Due to a very high temperature, the fuel gets ignited. This type of combustion is called constant pressure combustion (CP.C.) because the pressure inside the cylinder is almost constant when combustion is taking

place.

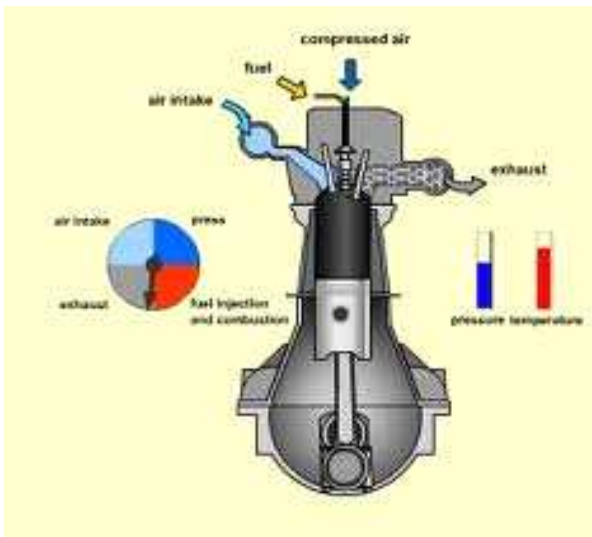
4. Based on working cycle

1. Four stroke cycle engine - When the cycle is completed in two revolutions of the crankshaft, it is called four stroke cycle engine.

2. Two stroke cycle engine. - When the cycle is completed in one revolution of the crankshaft, it is called two stroke cycle engine

CONSTRUCTION OF AN IC ENGINE

I.C. engine converts the reciprocating motion of piston into rotary motion of the crankshaft by means of a connecting rod. The piston which reciprocating in the cylinder is very close fit in the cylinder. Rings are inserted in the circumferential grooves of the piston to prevent leakage of gases from sides of the piston. Usually a cylinder is bored in a cylinder block and a gasket, made of copper sheet or asbestos is inserted between the cylinder and the cylinder head to avoid any leakage. The combustion space is provided at the top of the cylinder head where combustion takes place.

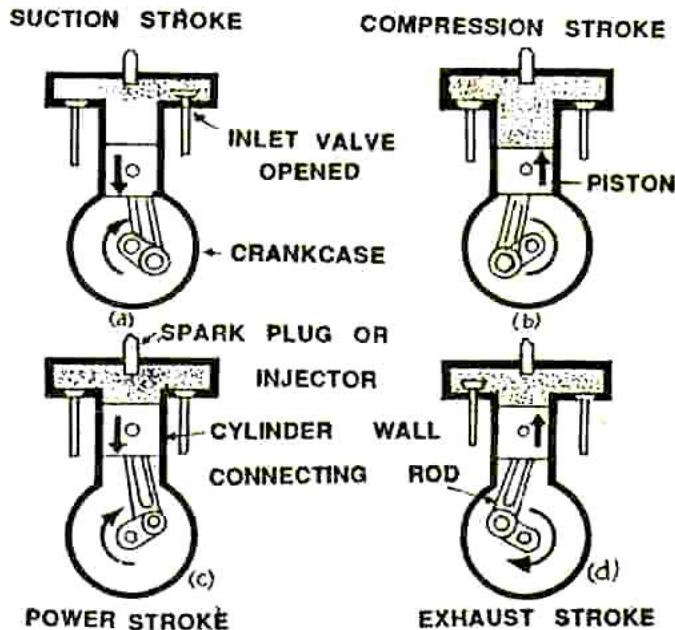


The connecting rod connects the piston and the crankshaft. The end of the connecting rod connecting the piston is called small end. A pin called gudgeon pin or wrist pin is provided for connecting the piston and the connecting rod at the small end. The other end of the connecting rod connecting the crank shaft is called big end. When piston is moved up and down, the motion is transmitted to the crank shaft by the connecting **FOUR STROKE ENGINE** rod and the crank shaft makes rotary motion. The crankshaft rotates in main bearings which are fitted the crankcase. A flywheel is provided at one end of the crankshaft for smoothing the uneven torque produced by the engine. There is an oil sump at the bottom of the engine

which contains lubricating oil for lubricating different parts of the engine.

Lecture Hour 2: FOUR STROKE ENGINE

A four-stroke engine (also known as four-cycle) is an internal combustion engine in which the piston completes four separate strokes which comprise a single thermodynamic cycle. A stroke refers to the full travel of the piston along the cylinder, in either direction. While risqué slang among some automotive enthusiasts names these respectively the "suck," "squeeze," "bang" and "blow" strokes, they are more commonly termed



1. **INTAKE:** this stroke of the piston begins at top dead center. The piston descends from the top of the cylinder to the bottom of the cylinder, increasing the volume of the cylinder. A mixture of fuel and air is forced by atmospheric (or greater) pressure into the cylinder through the intake port.

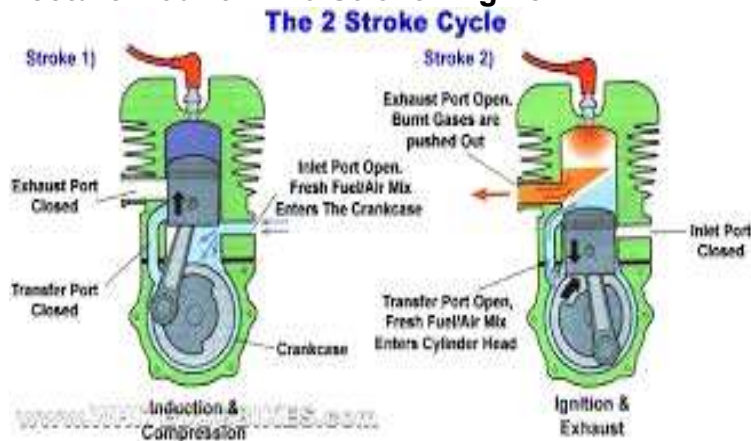
2. **COMPRESSION:** with both intake and exhaust valves closed, the piston returns to the top of the cylinder compressing the air or fuel-air mixture into the cylinder head.

3. **POWER:** this is the start of the second revolution of the cycle. While the piston is close to Top Dead Centre, the compressed air-fuel mixture in a gasoline engine is ignited, by a spark plug in gasoline engines, or which ignites due to the heat generated by compression in a diesel engine. The resulting pressure from the combustion of the compressed fuel-air mixture forces the piston back down toward bottom dead centre.

4. **EXHAUST:** during the exhaust stroke, the piston once again returns to top dead centre while the exhaust valve is open. This action expels the spent fuel-air

mixture through the exhaust valve(s).

Lecture Hour 3: Two Stroke Engine



In two stroke cycle engines, the whole sequence of events i.e., suction, compression, power and exhaust are completed in two strokes of the piston i.e. One revolution of the crankshaft. There is no valve in this type of engine. Gas movement takes place through holes called ports in the cylinder. The crankcase of the engine is air tight in which the crankshaft rotates.

Upward stroke of the piston (Suction + Compression)

When the piston moves upward it covers two of the ports, the exhaust port and transfer port, which are normally almost opposite to each other. This traps the charge of air- fuel mixture drawn already in to the cylinder. Further upward movement of the piston compresses the charge and also uncovers the suction port. Now fresh mixture is drawn through this port into the crankcase. Just before the end of this stroke, the mixture in the cylinder is ignited by a spark plug (Fig 2 c & d). Thus, during this stroke both suction and compression events are completed.

Downward stroke (Power + Exhaust)

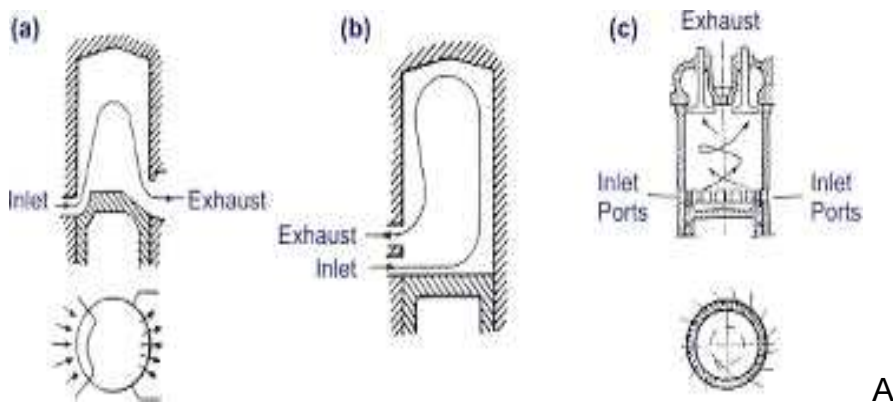
Burning of the fuel rises the temperature and pressure of the gases which forces the piston to move down the cylinder. When the piston moves down, it closes the suction port, trapping the fresh charge drawn into the crankcase during the previous upward stroke. Further downward movement of the piston uncovers first the exhaust port and then the transfer port. Now fresh charge in the crankcase moves in to the cylinder through the transfer port driving out the burnt gases through the exhaust port. Special shaped piston crown deflect the incoming mixture up around the cylinder so that it can help in driving out the exhaust gases. During the downward stroke of the piston power and exhaust events are completed.

Lecture Hour 4: Scavenging Process

SCAVENGING PROCESS

A basic part of the cycle of an internal combustion engine is the supply of fresh air and removal of exhaust gases. This is the gas exchange process. Scavenging is the removal of exhaust gases by blowing in fresh air. Charging is the filling of the engine cylinder with a supply or charge of fresh air ready for compression. With supercharging a large mass of air is supplied to the cylinder by blowing it in under pressure.

Efficient scavenging is essential to ensure a sufficient supply of fresh air for combustion. In the four-stroke cycle engine there is an adequate overlap between the air inlet valve opening and the exhaust valve closing. With two-stroke cycle engines this overlap is limited and some slight mixing of exhaust gases and incoming air does occur.



number of different scavenging methods are in use in slow-speed two-stroke engines. In each the fresh air enters as the inlet port is opened by the downward movement of the piston and continues until the port is closed by the upward moving piston. The flow path of the scavenge air is decided by the engine port shape and design and the exhaust arrangements.

Three basic systems are in use: the cross flow, the loop and the uniflow. All modern slow-speed diesel engines now use the uniflow scavenging system

with a cylinder-head exhaust valve.

CROSS FLOW SCAVENGING (Fig a)

In cross scavenging the incoming air is directed upwards, pushing the exhaust gases before it. The exhaust gases then travel down and out of the exhaust ports. Figure above illustrates the process.

LOOP FLOW SCAVENGING (Fig b)

In loop scavenging the incoming air passes over the piston crown then rises towards the cylinder head. The exhaust gases are forced before the air passing down and out of exhaust ports located just above the inlet ports. The process is shown in Figure below.

UNIFLOW SCAVENGING (Fig c)

With uniflow scavenging the incoming air enters at the lower end of the cylinder and leaves at the top. The outlet at the top of the cylinder may be ports or a large valve. The process is shown here.

Lecture Hour 5: Rotary Valve Engine

A rotary valve engine is always a two stroke engine. Most rotary valve engines are rotax engines. Although other rotary engines such as suzuki and kawasaki have been made.

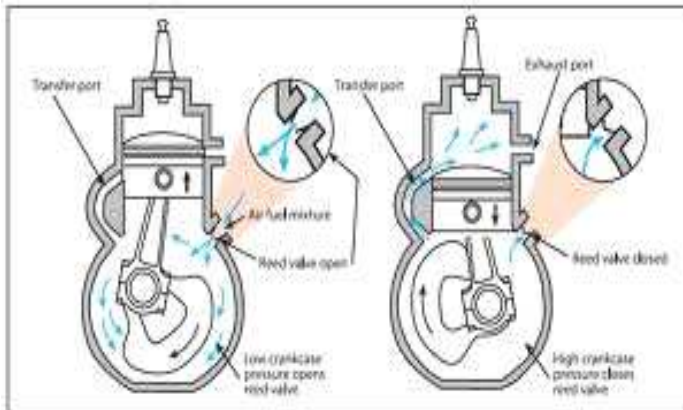


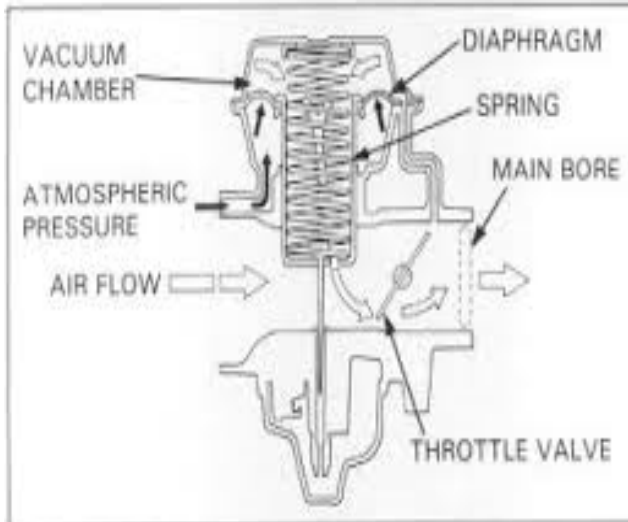
Figure 4-1. Reed valve is open with low pressure and closes when the pressure increases.

Rotax engines are used in snowmobiles, jet-skis and motorcycles and aircraft engines. A rotary valve refers to the intake of a two stroke engine.

There are three types of intake designs for two stroke engines. Simplistic two strokes are piston port, meaning that the piston movement past the port controls the incoming air timing. The piston port engine doesn't do a very good job of keeping the airflow to stay in the engine. The air can simply travel back out of the engine. The most popular intake air induction is the reed port engine. It

uses reed petals to allow the intake air in the engine and traps it there. The tension of the reed petals can change with the use of different petals and can provide some power improvement at certain rpm ranges. A rotary valve engine has the best intake air control

Lecture Hour 6: Constant Vacuum Carburetor



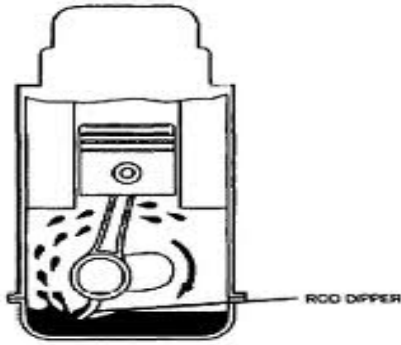
A vacuum actuated valve for a constant vacuum type carburetor is formed with a first guide hole, a jet needle engaging step portion and a jet needle insertion hole therein. A spring seat has an outer cylindrical portion in an upper portion thereof, and an inner cylindrical portion and a jet needle supporting cylindrical portion therein.

The outer cylindrical portion of the spring seat is arranged on the outer circumference of a diaphragm plate. The jet needle supporting cylindrical portion is inserted within a first guide hole. A lower end of a vacuum actuated valve return spring engages with a spring seating flange of the spring seat. A flange portion of a jet needle is restricted by the jet needle engaging step portion and the jet needle supporting cylindrical portion.

Lecture Hour 7: Splash Lubrication System

The splash system is no longer used in automotive engines. It is widely used in small four-cycle engines for lawn mowers, outboard marine operation, and so on.

In the splash lubricating system, oil is splashed up from the oil pan or oil trays in the lower part of the crankcase. The oil is thrown upward as droplets or fine mist and provides adequate lubrication to valve mechanisms, piston pins, cylinder walls, and piston rings.



In the engine, dippers on the connecting-rod bearing caps enter the oil pan with each crankshaft revolution to produce the oil splash. A passage is drilled in each connecting rod from the dipper to the bearing to ensure lubrication.

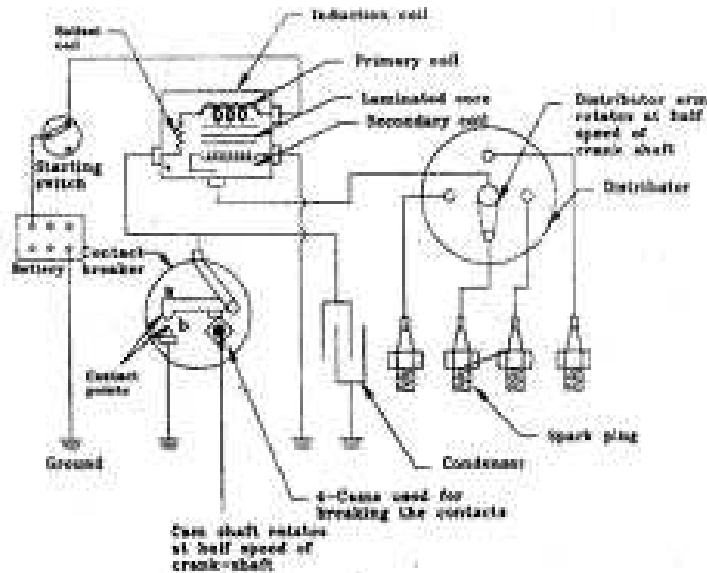
This system is too uncertain for automotive applications. One reason is that the level of oil in the crankcase will vary greatly the amount of lubrication received by the engine. A high level results in excess lubrication and oil consumption and a slightly low level results in inadequate lubrication and failure of the engine.

Lecture Hour 8: Battery Coil Ignition System & Magnetor ignition system

Figure 4.2 shows line diagram of battery ignition system for a 4-cylinder petrol engine. It mainly consists of a 6 or 12 volt battery, ammeter, ignition switch, auto-transformer (step up transformer), contact breaker, capacitor, distributor rotor, distributor contact points, spark plugs, etc.

Note that the Figure 4.1 shows the ignition system for 4-cylinder petrol engine, here there are 4-spark plugs and contact breaker cam has 4-corners. (If it is for 6-cylinder engine it will have 6-spark plugs and contact breaker cam will be a perfect hexagon).

The ignition system is divided into 2-circuits :

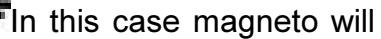


Primary Circuit : It consists of 6 or 12 V battery, ammeter, ignition switch, primary winding it has 200-300 turns of 20 SWG (Sharps Wire Gauge) gauge wire, contact breaker, capacitor. (ii) **Secondary Circuit :** It consists of secondary winding. Secondary winding consists of about 21000 turns of 40 (S WG) gauge wire. Bottom end of which is connected to bottom end of primary and top end of secondary winding is connected to centre of distributor rotor. Distributor rotors rotate and make contacts with contact points and are connected to spark plugs which are fitted in cylinder heads (engine earth).

(iii) **Working :** When the ignition switch is closed and engine is cranked, as soon as the contact breaker closes, a low voltage current will flow through the primary winding. It is also to be noted that the contact breaker cam opens and closes the circuit 4-times (for 4 cylinders) in one revolution. When the contact breaker opens the contact, the magnetic field begins to collapse. Because of this collapsing magnetic field, current will be induced in the secondary winding. And because of more turns (@ 21000 turns) of secondary, voltage goes up to 28000-30000 volts.

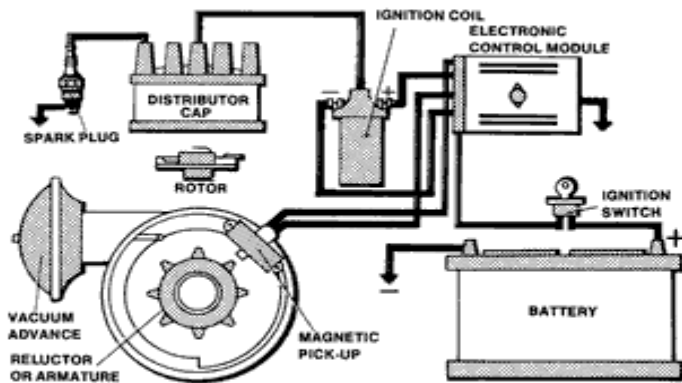
The need for higher mileage, reduced emissions and greater reliability has led to the development of the electronic ignition systems. These systems generate a much stronger spark which is needed to ignite leaner fuel mixtures. Breaker point systems needed a resistor to reduce the operating voltage of the primary circuit in order to prolong the life of the points. The primary circuit of the electronic ignition systems operate on full battery voltage which helps to develop a stronger spark. Spark plug gaps have widened due to the ability of the increased voltage to jump the larger gap. Cleaner combustion and less deposits have led to longer spark plug life.

MAGNETOR IGNITION SYSTEM



Lecture Hour 9: Electronic Ignition System

In some systems, the ignition coil has been moved inside the distributor cap. This system is said to have an internal coil as opposed to the conventional external one.



Electronic Ignition systems are not as complicated as they may first appear. In fact, they differ only slightly from conventional point ignition systems. Like conventional ignition systems, electronic systems have two circuits: a primary circuit and a secondary circuit. The entire secondary circuit is the same as in a conventional ignition system. In addition, the section of the primary circuit from the battery to the battery terminal at the coil is the same as in a conventional ignition system.

Electronic ignition systems differ from conventional ignition systems in the distributor component area. Instead of a distributor cam, breaker plate, points, and condenser, an electronic ignition system has an armature (called by various names such as a trigger wheel, reluctor, etc.), a pickup coil (stator, sensor, etc.), and an electronic control module.

Essentially, all electronic ignition systems operate in the following manner: With the ignition switch turned on, primary (battery) current flows from the battery through the ignition switch to the coil primary windings. Primary current is turned on and off by the action of the armature as it revolves past the pickup coil or sensor. As each tooth of the armature nears the pickup coil, it creates a voltage that signals the electronic module to turn off the coil primary current. A timing circuit in the module will turn the current on again after the coil field has collapsed. When the current is off, however, the magnetic field built up in the coil is allowed to collapse, which causes a high voltage in the secondary windings of the coil. It is now operating on the secondary ignition circuit, which is the same as in a conventional ignition system.

UNIT II CHASSIS AND SUB SYSTEMS

Lecture Hour 1: Single Plate Clutch

A clutch is a mechanical device that provides for the transmission power (and therefore usually motion) from one component (the driving member) to another (the driven member) when engaged, but can be disengaged.

Clutches are used whenever the transmission of power or motion must be controlled either in amount or over time (e.g., electric screwdrivers limit how much torque is transmitted through use of a clutch; clutches control whether automobiles transmit engine power to the wheels).

The three levers (also known as release levers or fingers) are carried on pivots suspended from the case of the body. These are arranged in such a manner so that the pressure plate moves away from the flywheel by the inward movement of a thrust bearing. The bearing is mounted upon a forked shaft and moves forward when the clutch pedal is pressed

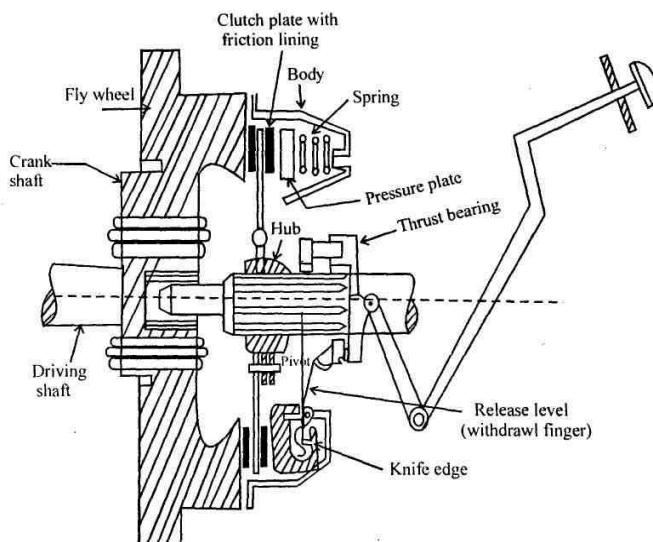


Fig. Single Plate Clutch

When the clutch pedal is pressed down, its linkage forces the thrust release bearing to move in towards the flywheel and pressing the longer ends of the levers inward.

The axial pressure exerted by the spring provides a frictional force in the circumferential direction when the relative motion between the driving and driven members tends to take place. If the torque due to this frictional force exceeds the torque to be transmitted, then no slipping takes place and the power is

transmitted from the driving shaft to the driven shaft.

Lecture Hour 2 : Multiplate Clutch

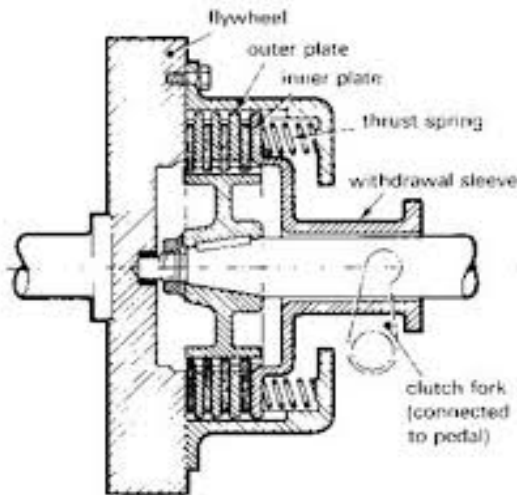


Fig. Multi plate clutch

Automobiles use various kinds of clutches such as singleplate or multiplate clutch. Each clutch has got its own design construction and working principle. Multiplate clutch consists of a number of clutch plates, whereas singleplate clutch has only one clutch plate. As the number of clutch plates are increased, the friction surface also increases. The increased number of friction surfaces in clutch increases the capacity of the clutch to transmit torque in automobiles.

The plates are alternately fitted to the engine shaft and gear box shaft. They are firmly pressed by strong coil springs and assembled in a drum. Each of the alternate plate slides in grooves on the flywheel and the other slides on splines on the pressure plate. Therefore, each alternate plate has inner and outer splines.

The multiplate clutches operating condition may be dry or wet. When the clutch is operated in an oil bath, it is called a wet [clutch](#). When the clutch is operated dry, it is called dry clutch. The wet clutches are generally used in conjunction with the automatic transmission automobiles.

Multiplate clutch works in the same way as the single plate clutch i.e. by operating the clutch pedal. The multiplate clutches are used in heavy commercial vehicles, **automobiles**, racing cars and motor cycles for transmitting high torque.

Lecture Hour 3: Centrifugal Clutches

A centrifugal clutch is a clutch that uses centrifugal force to connect two concentric shafts, with the driving shaft nested inside the driven shaft.



The input of the clutch is connected to the engine crankshaft while the output may drive a shaft, chain, or belt. As engine RPM increases, weighted arms in the clutch swing outward and force the clutch to engage. The most common types have friction pads or shoes radially mounted that engage the inside of the rim of a housing. On the center shaft there are an assorted amount of extension springs, which connect to a clutch shoe. When the center shaft spins fast enough, the springs extend causing the clutch shoes to engage the friction face. It can be compared to a drum brake in reverse. This type can be found on most home built karts, lawn and garden equipment, fuel powered model cars and low power chainsaws. Another type used in racing karts has friction and clutch disks stacked together like a motorcycle clutch. The weighted arms force these disks together and engage the clutch.

When the engine reaches a certain RPM, the clutch activates, working

almost like a continuously variable transmission. As the load increases the rpm drops, disengaging the clutch, letting the rpm rise again and reengaging the clutch. If tuned properly, the clutch will tend to keep the engine at or near the torque peak of the engine. This results in a fair bit of waste heat, but over a broad range of speeds it is much more useful than a direct drive in many applications.

Lecture Hour 4: CHASSIS

The two-wheeler chassis consists of the frame, suspension, wheels and brakes. The chassis is what truly sets the overall style of the two-wheeler. Automotive chassis is the main carriage systems of a vehicle. The type determines the gearing configuration, flex and the type of modifications that can be accommodated.

Frame: The frame serves as a skeleton upon which parts like gearbox and engine are mounted. It can be made of steel, aluminum or an alloy. It keeps the wheels in line to maintain the handling of the two-wheeler.

Suspension: It is a collection of springs and shock absorbers. It can be of two types: front suspension and rear suspension. It insulates both the rider and the bulk of the machine from road shocks and also keeps the wheels in the closest possible contact with the ground and gives control of the vehicle to the rider. The front suspension helps to guide the front wheel, to steer, to spring, to dampen, and to provide support under braking.

Wheels: A wheel is a circular object which with an axle, allows low friction in motion by rolling. A wheel is made up of the rim and spokes or disc plate. Wheels should be aligned properly because it directly influences driving. Two-wheeler wheels are generally of aluminum or steel rims with spokes.

Brakes: Generally, there are two independent brakes on a two-wheeler: one set on the front wheel and one on the rear, however, there are many models which have 'linked brakes' and apply both at the same time. The front brake is generally much more powerful than the rear brake. Brakes can either be drum or disc based. When the rider operates one of the brakes, a fluid element known as hydraulics is pressurized to provide the required forces to squeeze the brake pad material onto the rotor and slow down or stop the vehicle.

GEAR BOX

A gear is a toothed wheel designed to transmit the force to another gear or toothed component. The teeth of a gear is known as cogs. They are shaped to minimize wear, vibration and noise and at the same time maximize the efficiency of power transmission.

Gears of different size, the larger one is called a wheel and the smaller one is called a pinion, are used in pairs so that the force of the driving gear can produce a larger force in the driven gear, that also at a lower speed or it can be for the purpose of producing a smaller force at a higher speed.

Lecture Hour 5: Gear Box:

The motorcycle gear box contains a number of gears in different sizes. In the process of gear switching, different pairs of gearwheels lock together. A large and small wheel lock together in the lowest or slowest gear. Similar size wheels lock together in the highest or fastest gear.

The motorcycle gear box is the component that makes the actual ratio between the engine and the driving wheels. It is also referred to as transmission gear.

Types of Motorcycle Gear Box:

In a general manner, the motorcycle gear box can be of three types, they are:

- **Horizontally Split:** It has a seam on the horizontal plane.
- **Vertically Split:** It has a seam on the vertical plane.
- **Cassette Type:** The gears are loaded in from one side.

Characteristics of Gear Box:

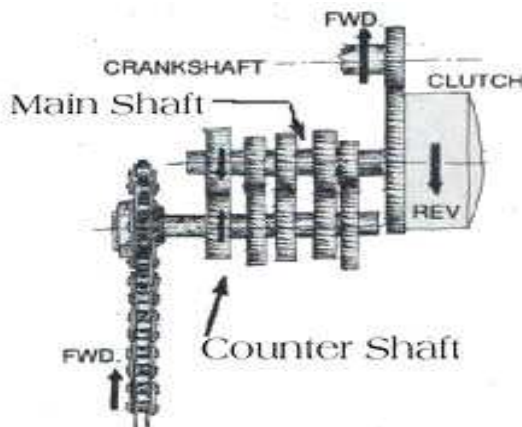
The gears are constantly meshed with one another and they are always spinning.

Uses of Gear Box:

- It controls gear and shaft alignment.
- It controls the engine RPM.
- It protects the gears and lubricants from water, dust and other environmental contaminants.

Function of Gear Box:

A gearbox is a mechanical method of transferring energy from one device to another and is used to increase torque while reducing speed. Torque is the power generated through the bending or twisting of a solid material. This term is often used interchangeably with transmission



It is located at the junction point of a power shaft, the gearbox is often used to create a right angle change in direction, as is seen in a rotary mower or a helicopter. Each unit is made with a specific purpose in mind, and the [gear ratio](#) used is designed to provide the level of force required. This ratio is fixed and cannot be changed once the box is

constructed. The only possible modification after the fact is an adjustment that allows the shaft speed to increase, along with a corresponding reduction in torque.

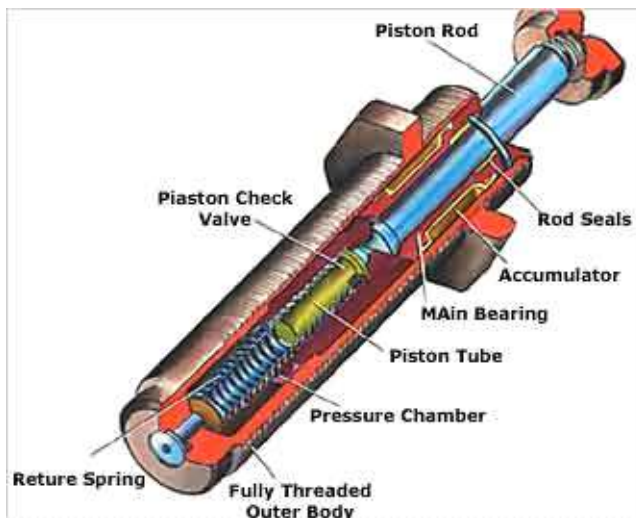
In a situation where multiple speeds are needed, a transmission with multiple gears can be used to increase torque while slowing down the output speed. This design is commonly found in automobile transmissions. The same principle can be used to create an overdrive gear that increases output speed while decreasing torque.

Lecture Hour 6: Shock Absorber

A Two Wheeler Shock Absorber is a mechanical device meant to smooth out or damp a sudden shock impulse and dissipate kinetic energy. It is also known as Damper. Shock absorbers must absorb or dissipate energy.

Functions of Two Wheeler Shock Absorbers:

- They absorb the shock from bumps on the road and helps to make riding safe and smooth.
- They allow the use of soft springs while controlling the rate of suspension movement in response to bumps.
- They also, along with hysteresis in the tire itself, damp the motion of the unsprung weight up and down on the springiness of the tire.
- Shock Absorber system make the vehicle manageable.



Materials used for making Shock absorbers:

The most commonly used materials for making these absorbers are:

- Steel
- Aluminum

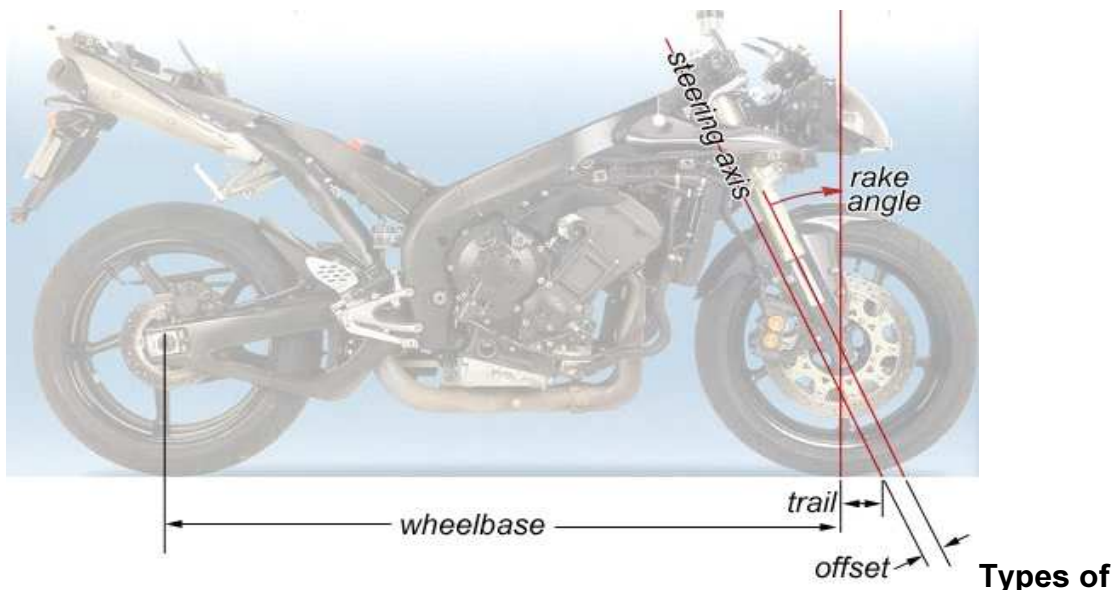
Maintenance of Shock Absorbers:

- It should be checked regularly.
- Oils should be changed according to the recommended time.

Lecture Hour 7: SUSPENSION SYSTEM

Introduction:

A Motorcycle Suspension System consists of a spring coupled to a viscous damping element, a piston, in a cylinder filled with oil. The piston smooths out vibrations induced by the vehicle while moving as it moves through the oil. The flow of oil through the piston is regulated by an adjustable elastic deformable flap called a shim.



Motorcycle Suspension:

- **Front Suspension:** The predominant type of front suspension is the suspension fork. The bottom part of the fork is fitted over the tubes that

connect the fork to the frame. When the vehicle hits a bump, the spring gets compressed and the piston forces fluid through the orifice.

- Rear Suspension: Most of the time the rear suspension are used as a shock absorber.

Functions of Motorcycle Suspension:

The main functions of the motorcycle suspensions are:

- To insulate both the rider and the bulk of the machine from road shocks. It makes a much safer and comfortable ride and is important for proper mechanical reliability and longevity.
- To keep the wheels in the closest possible contact with the ground and gives control of the vehicle to the rider.
- The front suspension helps to guides the front wheel, to steer, to spring, to dampen, and to provide support under braking.

Materials used for making Suspensions:

The materials most commonly used for making suspensions are:

- Steel
- Aluminum

Maintenance of Suspensions:

- The suspensions should be checked for loose nuts and bolts and leaks.
- The swing arm bearings should be lubricated monthly.

Lecture Hour 8: FRONT SUSPENSION

Front suspension is often implemented with a set of shock absorbers in the front fork. The suspension travel and handling characteristics vary depending on the type of mountain biking the fork is designed for. For instance, manufacturers produce different forks for cross-country (XC), downhill (DH), and freeride riding.

Suspension fork design has advanced in recent years with suspension forks becoming increasingly sophisticated. The amount of travel available has typically increased. When suspension forks were introduced 80-100 mm of travel was deemed sufficient for a downhill mountain bike. Typically this amount of travel is now more normal for cross country disciplines. Downhill forks can now offer in the region of 170 to 203 mm of travel for handling the most extreme terrain.

Other advances in design include adjustable travel allowing riders to adapt the forks travel to the specific terrain profile. eg less travel for uphill sections more travel for downhill sections. Advanced designs also often feature the ability to lockout the fork to completely eliminate or drastically reduce the fork's travel for more efficient riding over smooth sections of terrain. This lockout can sometime be activated remotely by a cable and lever on the handlebars.



The shock absorber usually consists of two parts:
a spring and a **damper or dashpot**.

The spring may be implemented with a steel or titanium coil, an elastomer, or even compressed air. The choice of spring material has a fundamental effect on the characteristics of the fork as a whole. Coil spring forks are often heavier than designs which use compressed air springs, however they are more easily designed to keep a linear spring rate throughout their travel. Substituting titanium coils in favor of steel coils in a design can decrease the weight of the design but leads to an increase in expense. Air springs work by utilizing the characteristic of compressed air to resist further compression. As the "spring" is provided by the compressed air rather than a coil of metal they can often be made lighter; this makes their use more common in cross country designs. Another advantage of this type of fork design is that the spring rate can easily be adjusted by adjusting the pressure of the air in the spring. This allows a fork to be effectively tuned to a rider's weight. One disadvantage of this design is the difficulty in achieving a linear spring rate throughout the fork's action. As the fork compresses, the air held inside the air spring also compresses; towards the end of the fork's travel, further compression of the fork requires ever increasing compression of the compressed air with the spring. This results in an increase in spring rate. Increasing the volume of the air inside the spring can reduce this effect but the volume of the spring is ultimately limited as it needs to be contained within the dimension of the fork leg.

The damper is usually implemented by forcing oil to pass through one or more small openings or shim stacks. On some models, the spring, the damper, or both may be adjusted for rider weight, riding style, terrain, or any combination of these or other factors. The two components may be separated with the spring mechanism in one leg and the damper in the other.

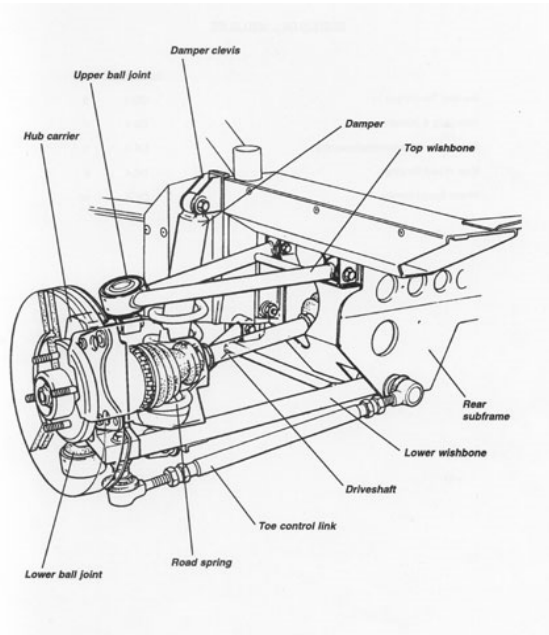
Some manufacturers, especially Cannondale, have tried other variations including a single shock built into the steering tube above the crown and a fork with just a single leg that has a shock built into it. Others have marketed

suspension forks that employ linkages to provide the mechanical action instead of relying upon telescoping elements.

Lecture Hour 9: REAR SUSPENSION

Perhaps because front suspension has been easier to implement and more readily adopted, it is often assumed, and rear suspension is sometimes synonymous with full suspension.

Full suspension mountain bike technology has made great advances since first appearing in the early 1990s. Early full suspension frames were heavy and tended to bounce up and down while a rider pedaled. This movement was called pedal bob, kickback, or monkey motion and took power out of a rider's pedal stroke — especially during climbs up steep hills. Input from hard braking efforts (known as brake jack) also negatively affected early full suspension designs. When a rider hit the brakes, these early designs lost some of their ability to absorb bumps — and this happened in situations where the rear suspension was needed most.



The problems of pedal bob and brake jack began to be solved in the early 1990s. One of the first successful full suspension bikes was designed by Mert Lawwill, a former motorcycle champion. His bike, the Gary Fisher RS-1, was released in 1990. It adapted the A-arm suspension design from sports car racing, and was the first four bar linkage in mountain biking. This design solved the twin problems of unwanted braking and pedaling input to the rear wheel, but the design wasn't flawless. Problems remained with suspension action under acceleration, and the RS-1 couldn't use traditional cantilever brakes. A lightweight, powerful disc brake wasn't developed until the mid 1990s, and the disc brake used on the RS-1 was its downfall.

Horst Leitner began working on the problem of chain torque and its effect on suspension in the mid 1970's with motorcycles. In 1985 Leitner built a

prototype mountain bike incorporating what became known later as the "Horst Link". Leitner formed a mountain bike and research company, AMP research, that began building full-suspension mountain bikes. In 1990, AMP introduced the Horst link as a feature of a fully independent linkage rear suspension for mountain bikes. The AMP B-3 and B-4 XC full-suspension bikes featured active Horst Link/Macpherson strut rear suspensions and optional disc brakes. A later model, the B-5, was equipped with both the Horst link and a four-bar active link suspension featuring up to 125 mm (5 inches) of travel on a bicycle weighing around 10.5 kg (23 pounds). For 10 years AMP Research manufactured their full-suspension bikes in small quantities in Laguna Beach, California, including the manufacture of their own cable-actuated-hydraulic disc brakes, hubs, shocks and front suspension forks.

UNIT III BRAKES, WHEELS AND TYRES

Lecture Hour 1 : Introduction:

Brakes are the devices for slowing and stopping the vehicle. The braking operation is reverse of the acceleration to the vehicle.

Purpose of brakes:

The main purpose of fitting brakes on motor vehicle are as given under

- (i) In emergencies to bring the vehicle to rest in the shortest possible distance
- (ii) To control the vehicle when it is descending along the hills.
- (iii) To keep the vehicle in desired position after bringing it in complete rest when there is no driver

To fulfill the above needs two independent braking system are provided in the vehicle.

- (a) Service brake which is operated by foot pedal in regular operation
- (b) Emergency brake which is operated by a hand lever while parking the vehicle

Some very important aspects about the Braking System are:

1. It is important that there is no air in the hydraulic braking system. Bleeding of the system is the means of keeping the hydraulic braking system air-free.
2. The amount of friction material on the brake pads are very important, replacing worn brake pads is the quickest way to increase the braking power of a vehicle.
3. The condition of the brake fluid is very vital.
4. The braking system requires constant checking and worn and torn parts should be replaced.
5. Lubrication is a must to lengthen the life of the brake system parts.

Parts of a Brake System:

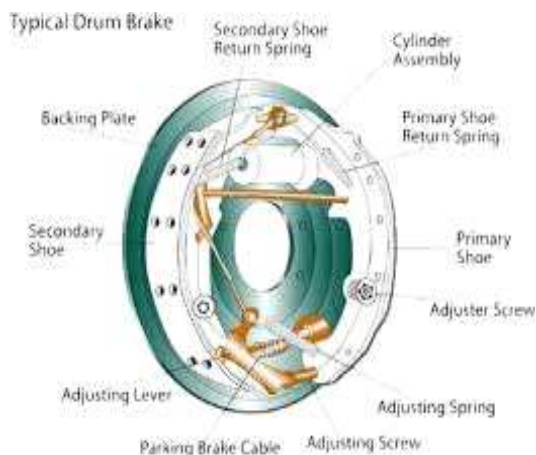
The important parts of a Brake System are:

- Brake Pads
- Brake Levers
- Brake Shoes
- Brake Lining
- Brake Drums
- Sprockets
- Brake Wire/Line
- Brake Cylinder
- Brake Fluid

Components of Disk brake:

- brake calipers
- brake pads
- rotors

Lecture Hour 2: Drum brake



The principle of operation of drum brakes

In the drum brake friction force is due to the fact that under the action of the cam forces the brake pads located inside the inner surfaces are pressed against the brake drums. Thanks much private housing pads are well protected from the effects of corrosion (water, salt, dust) and dirt (sand, stones, mud), even when driving on hard terrain. When using the brakes, S-shaped cam brake cylinder by adjusting the brake lever and the shaft rotates the S-shaped cam, thereby pressing the brake shoes with linings to the brake drum. Adjusting levers Automatic self-adjusting levers align the brake pads wear and drums, establishing between them a constant air gap.

Drum Brakes benefits

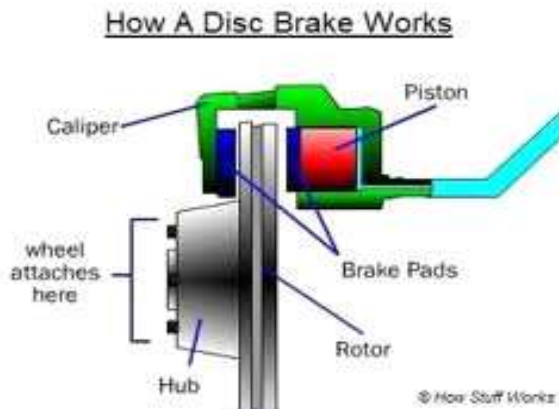
- Durability and reliability
- Suitability for heavy applications, even on dirt roads and in difficult

environments

- Variety of options for different vehicles and applications
- Simple and priced maintenance and repairs

Lecture Hour 3: Disc Brake

When a brake lever or pedal is pressed, the push rod which is connected to lever or pedal and master cylinder piston pushes the master cylinder piston. This movement allows the master cylinder piston to slide and push the return spring inside the bore of master cylinder, which generates pressure in reservoir tank. At this moment a primary seal allows the brake fluid of reservoir tank to flow over it into the brake hosepipes. A secondary seal ensures that the brake fluid does not go other side.



Then the fluid enters in to cylinder bore of caliper assembly via brake hosepipes and pushes the caliper piston or pistons. At this time the piston ring moves in rolling shape with piston. Then the caliper piston pushes brake pad. This movement causes brake pads to stick with brake disc which creates friction and stops the brake disc/rotor to rotate. This way disk brake system stops or slows down the vehicle.

When the brake lever or pedal is released the piston ring pushes the caliper piston back to cylinder bore of caliper till both, caliper piston and piston ring come into their original shape. At this time retraction spring pushes the brake pads to their original position. The return spring in master cylinder assembly pushes the master cylinder piston back into its original position and allows the fluid to flow back to reservoir via hosepipe and master cylinder bore.

Advantages of Disk Brake:

- Disk brake requires less effort (brake torque) to stop the vehicle compare to drum brake.
- It generates less heat compare to drum brake for the same brake torque.
- Ease of maintenance as disk brake is outside the wheel rim.
- It cools down faster compare to drum brake.
- If worn out brake shoes are not changed at proper time it can cut the

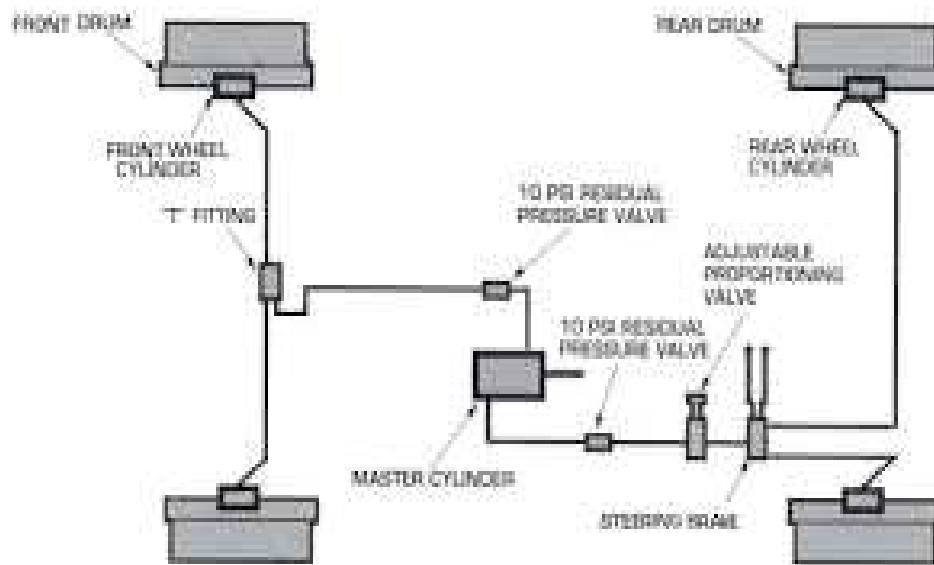
brake drum in drum brake. Disk brake does not have such problem.

- It is less likely to skid compare to drum brake in wet condition.
- It is much safer than drum brake in hard braking condition. Under such condition drum brake can lock up the rear wheel.
- It has brake pad wear indicator which is not there in drum brake.

Disadvantages of Disk Brake:

- It is expensive compare to drum brake.
- More skills require to operate disk brake compare to drum brake that's the reason why some people are not comfortable with disk brake
- If any air remains in disk brake system, it can cause accident as the brake will not work effectively.
- Disk brake assembly has more moving parts and much complex than drum brake.
- It requires lot of effort at maintenance front like brake fluid (bleeding), change of brake pads etc compare to drum brake.

Lecture Hour 4: Brake Layout



Wheel parts:

A wheel is a circular object which with an axle, allows low friction in motion by rolling. A wheel is made up of the rim and spokes or disc plate. The standard size of wheels for two-wheelers is 17 inch. Wheels should be aligned properly because it directly influences driving.

Lecture Hour 5: Wheels

Wheels must be strong enough to support the vehicle and withstand the forces caused by normal operation. At the same time, they must be as light as possible, to help keep un-sprung weight to a minimum. Wheels can be made from cast aluminium alloy or magnesium alloy. Alloy wheels are popular because of their appearance and because they are lighter than similar steel wheels. Aluminium is a better conductor of heat, so alloy wheels can dissipate heat from brakes and tyres more effectively than steel ones. Most wheels have ventilation holes in the flange, so air can circulate to the brakes. Most passenger car wheels are of well, or drop-centre design. This design allows for tyre removal and fitting. The removal and fitting of tyres should be carried out according to manufactures instructions.

Types of Wheels

Passenger cars normally use rims which are of well based, or drop-centre design. The drop enter is used for mounting and demounting the tyre onto the rim. Wheels must be strong enough to carry the mass of the vehicle and withstand the forces that are generated during use. The wheel centre must accurately locate the wheel rim centrally on the axle. It must also provide the required distance from the centreline of the wheel, to the face of the mounting flange. This is called offset. Offset is important because it brings the tyre centreline into close alignment with the larger inner hub bearing and reduces load on the stub axle.

This allows the inside of the wheel centre to be shaped to provide space for the brake assembly, usually located inside the wheel. Ventilation slots allow air to circulate around the brakes. The rim must be accurately shaped and dimensioned and strong enough to support the tyre under the load of the vehicle and the forces generated by the motion of the vehicle. When inflated, the tyre is locked to the rim by tapering the bead seat towards the flange, or by safety ridges or humps, close to the flange. In the event of sudden deflation, or blow-out, safety ridges prevent the tyre moving down into the well. This helps maintain control of the vehicle while the brakes are applied. Well-based rims can also be used on heavy commercial vehicles for tubeless tyres.

Lecture Hour 6: Spoked Wheel

UNIT IV TWO WHEELERS

Lecture Hour 1: Introduction to Moped, Scooter, and Motorcycle

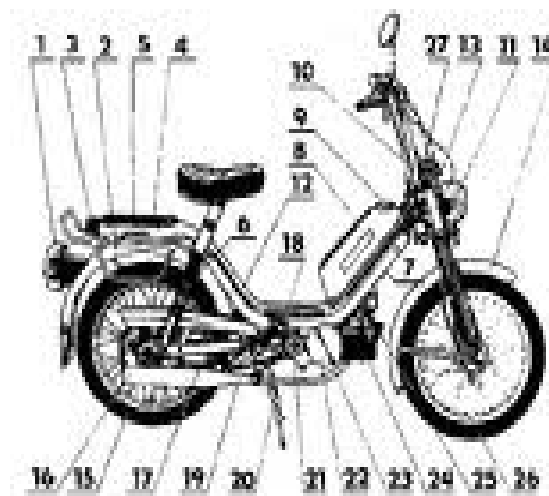
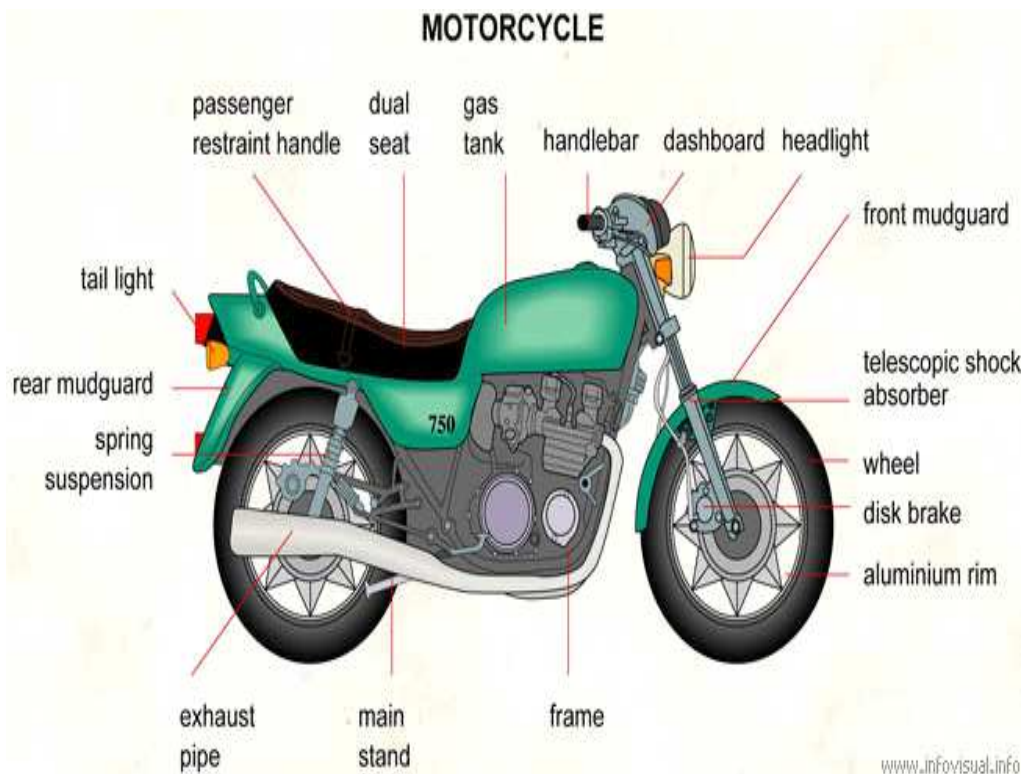


Fig. 1 Jawa Moped — Main Parts

1. Tail lamp, 2. Rear mudguard, 3. Tire pump, 4. Luggage carrier, 5. Tool kit, 6. Rear telescopic suspension unit, 7. Intake air cleaner, 8. Fuel tank, 9. Fuel tank filler cap, 10. Handlebars, 11. Headlamp, 12. Frame, 13. Front fork, 14. Front mudguard, 15. Rear wheel, 16. Exhaust silencer, 17. Pedal drive transmission chain, 18. Pedal cranks and pedals, 19. Engine drive transmission chain, 20. Stand, 21. Engine drive disengaging leg, 22. Alternator (under cover), 23. Exhaust pipe, 24. Engine, 25. Spark plug with cable cover, 26. Front wheel, 27. Speedometer.





Lecture Hour 2: Technical specification of MOPED

TECHNICAL SPECIFICATIONS OF TVS XL

Engine

Type	2 stroke single cylinder
Bore x Stroke (mm)	46 x 42
Displacement (cc)	69.9
Max. power	2.61 Kw(3.5 Bhp) @ 5000 rpm
Torque (Nm)	5.0 @3750 rpm

Drive

Clutch	Centrifugal wet type
Primary Drive	Single speed gear box
Secondary Drive	Roller chain drive

Electricals

Ignition System	Fly wheel magneto 12V, 50W Electronic ignition
Head Lamp	12V - 35/35W

Tail Lamp	12V - 5W
Brake Lamp	12V -10W
Speedo Lamp	12V -3.4W
Horn	12V - AC type
Indicator Lamp	12V -5W

Suspension

Front	Oil - filled telescopic spring assisted shocks
Rear	Adjustable hydraulic spring arm shocks

Dimensions & Weights

Wheelbase (mm)	1222
Dry Unladen Weight (kg)	75
Gross Vehicle Weight (kg)	205
Fuel Tank Capacity	4 ltr. (incl. 1 ltr. reserve)
Tyre Size (Fr & Rr)	2.5 x 16

Brake Drum

Front (mm)	80 dia
Rear (mm)	110 dia

Lecture Hour 3: Technical specification of Scooter
Technical specification of LML Vespa

Engine Specifications:

- LML Vespa NV & Select II :Displacement 150 cc , 2 Stroke , Three Port , Disc Valve
8.2 BHP @ 5500 rpm
Vespa 150(62 & 69) : Displacement 150cc , 2 Stoke , Single Cylinder
6.25 BHP @ 5000 rpm
- LML Vespa Alfa : Displacement 110cc
- Lambretta : Displacement 150cc , 2 Stroke , Single Cylinder . 6.5 BHP @ 5300 rpm
- Vespa PVX : Displacement 100cc, 2 Stroke,Single Cylinder 4.5 BHP @ 5500 rpm
- Vespa 150 (62 & 68) : Displacement 150cc,2 Stroke

Engine Misc.:

- N/A

Turbocharger & Induction:

- Stock

Fuel & Tuning:

- HP Unleaded
Castrol 2 T Engine Oil

Exhaust:

- Stock

Drivetrain:

- 4 Forward Gears
Wet Clutch plate

Weight reduction & transfer:

- N/A

Suspension, wheels & tires:

Suspension, wheels & tires:

Front suspension type : Single Sided Trailing Link Suspension

Rear Suspension : Coil Spring Shock Absorbers

Tire Size: Front : 3.5 x 10" Ceat Secura

Rear : 3.5 x 10" Ceat Secura

Interior:

- N/A

Exterior:

Colour : LML Vespa - Misty Silver

Vespa 150 – Midnight Black

Vespa 150 - Flame Orange

Lambretta - Red and Cream Dual Tone

Vespa PVX - Crsytal White and Turquoise Blue Dual tone

LML Vespa Select - Night Blue and White

LML Vespa Alfa - Lilac

Lecture Hour 4: Technical specification of Motorcycle

Passion-pro

Technical Specifications

Engine

- Type

Air-cooled, 4-stroke single cylinder OHC

- Displacement

97.2 cc

- Max. Power
5.74 kW (7.8 Ps) at 7500 rpm
- Max. Torque
0.82 Kgf-m (8.04 N.m) at 4500 rpm
- Max. Speed
--
- Acceleration
--
- Bore x Stroke
50.0 x 49.5 mm
- Carburettor
Side Draft, Variable venturi type with TCIS
- Compression Ratio
9.0: 1
- Starting
Electric start / Kick start
- Ignition
DC - Digital CDI with TCIS
- Oil Capacity
1.05 litres
- Oil Grade
SAE 10W 30 SJ Grade (JASO MA)

Lecture Hour 5: YAMAHA MOTOR CYCLE



ENGINE

Engine type	Air-cooled, 4-stroke, SOHC
Displacement	153.0cc
Bore & Stroke	58.0 × 57.9mm
Compression ratio	9.5:1
Maximum output	14PS @ 7500 rpm
Maximum torque	13.6 N.m @ 6000 rpm
Starting method	Electric & Kick
Lubrication type	Wet Sump
Fuel Supply	Carburetor
Clutch type	Wet, multiple-disc
Primary/secondary reduction ratio	3.409 / 2.857
Transmission type	Constant mesh 5-speed
Gear ratio	1st=2.714 2nd=1.789 3rd=1.318 4th=1.045 5th=0.875
Cylinder layout	Single Cylinder
Battery	12 V, 5.0 Ah

CHASSIS

Frame type	Diamond
Suspension (front/rear)	Telescopic/ Swingarm
Wheelbase	1,334mm
Brake type(front/rear)	Disc/Drum
Tire size (front/rear)	100/80-17 / 140/60-R17
Headlight	12 V, 35/35W
Caster / trail	25 degree/ 101 mm

DIMENSIONS

Overall Length × Width × Height	2075mm x 770mm x 1090mm
Seat height	790 mm
Wheelbase	1,334 mm
Minimum ground clearance	160 mm
Kerb weight	135 kg
Fuel tank volume	12 liters

Lecture Hour 6: Trouble Shooting of Motorcycle

It just cranks and cranks...

Many things can be responsible for a motorcycle that won't start. Some small, some bigger. Usually it's a minor problem and once corrected, the cycle will start properly. Following certain procedures can make troubleshooting this problem easier. This article will give you general troubleshooting methods, but you should be sure to have your factory service manual on hand.

Beginning The Process

The first step in troubleshooting a motorcycle that won't turn over is trying to start the engine. Listen and observe carefully to see if the engine doesn't rotate, makes unusual noises, or has inadequate compression.

If the engine displays any of these symptoms, then the problem is internal and requires a more extensive repair. If the engine doesn't turn over in neutral, then it has seized or "locked-up" and the problem lies with either crankshaft, connecting rod, or piston. This can be caused by a variety of problems, including valve seizure, rocker arm seizure, cylinder or piston seizure, connecting rod seizure, transmission gear or bearing seizure, and camshaft seizure.

When checking for engine rotation, also check the clutch. If the clutch is worn and slipping badly, it will appear that the engine is turning when it is actually locked-up.

Unusual noises can be caused by a variety of problems. For example, a heavy clunking sound coming from the bottom end could indicate a loose connecting rod.

Lack of compression is usually a problem caused by the pistons, rings, valves, or cylinder bore. If the bottom-end parts seem to be working correctly, then the problem is combustion related.

After checking the basics, then we move on to the essentials: Fuel, compression, and ignition.

Checking The Fuel Supply

When troubleshooting this problem, check for fuel in the tank, fuel flow to the carburetor, and fuel flow from the car to the engine. Restricted or no fuel flow can be caused by clogged fuel petcock, fuel tank air vent obstruction, clogged fuel line, or clogged float valve

Trace the system to check for blockage. Start with the fuel tank air vent, then the fuel petcock, fuel line, and float valve. Fuel restriction to the engine is indicated by a dry spark plug.

Fuel flow from the carb to the engine can be interrupted by air leaks between the carburetor and the inlet manifold. If you have a two-stroke engine, this can be caused by bad bottom-end engine seals.

A wet spark plug indicates a "flooded" engine. A supply of gas that is too much for the engine to burn can be caused by a closed air choke valve, a dirty air cleaner, a worn or stuck float valve, or even improper starting technique.

To eliminate an improper starting technique when dealing with a flooded engine, hold the throttle fully open when cranking over the engine. This will allow more air to reach the engine.

Check to see that the choke is open, then check and clean the air filter as needed. Make sure the carburetor float isn't stuck open. To fix this, you have to remove the float bowl and repair or clean it. Refer to your factory service manual for exact instructions on removing the float bowl on your make and model.

Lecture Hour 7: Trouble Shooting continuous

Checking For Compression

The pistons, rings, valves, spark plugs, and cylinder need to form an air-tight seal that will allow the air/fuel mixture to compress to the point of combustion. These parts are checked with a compression gauge. Compression has to be within factory specs, which you will find in your factory service manual.

With four-stroke engines, low compression requires a leakdown test, which provides a more accurate indication of the problem area.

Low compression can be caused by a loose spark plug, cylinder heads that are not properly tightened down, no valve clearance, worn cylinder walls or pistons, worn/broken/sticking piston rings, damaged head gasket, warped cylinder heads, weak or broken valve spring, or valves that are not properly seated.

Checking The Ignition System

Usually, if the engine is getting good compression and the ignition system is in

good running order, then the engine will start, even if it is flooded. And so, if there is compression and fuel flow, but the engine still doesn't start, then there is more than likely a problem with the ignition system.

Start by checking the battery, then fuses and switches, then the spark plugs, and last the ignition system.

Always check the obvious first. Make sure all ignition-related switched are in the Run position. It's not unusual to find a motorcycle or ATV that won't run because the ignition switches are in the Off position.

Turn on the lights. If they burn brightly, then more than likely your battery is charged. You can check this with a voltmeter. It should be within 0.5 of the specified voltage. In other words, if you have a 12 volt battery, then the voltmeter should read no less than 11.5 volts. If the battery is charged and the lights still don't work, check the fuse. If the fuse is good, try cleaning the battery terminals. If the battery cable ends are corroded, they can prevent the flow of current.

If the engine still won't start after checking compression, fuel flow, and current to the ignition, then check the spark plugs. Remove a plug and check the gap, make sure there aren't carbon deposits between the electrodes and the plug hasn't been fouled by too much gasoline. The check the plug for spark.

To do this remove the plug from the head, run a high-tension lead wire from the coil to the plug, and ground the metal part of the plug against the cylinder head or engine block. Turn the engine over. The plug should always fire a blue spark. A red or yellow spark indicates a weak point in the ignition system. If you don't get a sharp blue spark, the plug itself could be bad. Retest with a new spark plug.

No spark or a weak spark can be caused by low battery voltage, dirty/broken/misadjusted spark plug, bad spark plug wire or not not making good contact, wrong spark plug in use for your model, IC igniter trouble, neutral/starter/side stand switch malfunction, pickup or ignition coil trouble, ignition or engine stop switch that is shorted, shorted wiring, or a blown fuse.

If the plugs aren't the problem, then the issue lies with the ignition system itself. Please refer to your factory service manual for exact ignition system troubleshooting methods.

Disclaimer: Results may vary. The owner of this page makes no guarantees nor accepts any responsibility for any damages.

Lecture Hour 8: Trouble Shooting of Moped
Engine Does Not Start / Running Engine Stops
Version One

The problem is listed with the solution in parentheses.

- Fuel valve is closed. (Open [petcock]] or switch fuel valve to "reserve.")
- Fuel tank is empty. (Switch fuel valve to "reserve" or fill with fuel mixture.)
- [Spark plug](#) is contaminated. (Clean spark plug.)
- Spark plug is defective. (Replace spark plug.)
- Ignition cable has worked loose or come off. (Properly plug spark connector.)
- Too much or too little gas. (Open throttle about 1/3.)
- Vehicle put out of operation with fuel valve open. (Start with throttle wide open.)
- Choke operated with warm engine. (Remedy as above.)
- [Petcock](#) is clogged. (Have it cleaned by a workshop.)
- Main [jet](#) is clogged. (Clean main jet.)
- [Float needle](#) not fixed in its notch. (Remove float needle and engage it.)

Version Two

The engine will not start because...

There is no ignition spark because

- [Spark plug](#) is oiled, wet, or damaged.
- Spark plug is wet (outside).
- Ignition cable is loose or broken.
- Short-circuit switch jams or leads from engine are damaged.
- Contact breaker [points](#) are oiled up, wet, or fused.
- Ignition armature or [condenser](#) is damaged.

Engine is getting no fuel because

- No fuel in tank.
- Fuel valve/[petcock](#) closed.
- Strainer in the fuel valve/petcock clogged with dirt.
- [Fuel line](#)/hose jammed.
- [Jets](#) clogged.

There is no ignitable mixture because

- [Fuel/air mixture](#) too rich due to excessive priming.
- Water in [carburetor](#).
- Wrong [fuel/air mixture](#) due to loose carburetor.

Lack of compression because

- [Piston rings](#) broken.

- [Piston](#) and [cylinder](#) excessively worn.
- [Cylinder head](#) or spark plug loose.
- [Decompression](#) Valve dirty or stuck.

Engine Runs Unevenly or Misfires

The problem is listed with the solution is in parentheses.

- There is not enough fuel in the tank. (Open fuel valve to "reserve" and fill with gasoline mixture.)
- [Float](#) leaks. (Replace float.)
- Ignition cable is not properly connected. (Properly plug spark connector.)
- Spark plug is defective. (Replace spark plug.)
- Jet needle is loose. (Clamp needle in its notch.)

Engine Power Drops / Poor Performance

Version One

The problem is listed with the solution is in parentheses.

- [Choke](#) is working all the time. (Push back choke – full throttle.)
- [Exhaust pipe](#) is clogged. ([Cleaning the muffler](#).)
- [Spark plug](#) is defective. (Replace spark plug.)
- [Exhaust port](#) is clogged. (Clean exhaust port.)
- [Float](#) leaks, float needle deformed/jams. (Check all parts of the float chamber and replace if necessary.)
- [Float needle](#) is loose. (Clamp needle in its notch.)
- [Air filter](#) is clogged. (Clean air filter.)
- [Spark plug gap](#) is set incorrectly. (Gap spark plug correctly.)

Version Two

Engine power drops...

Due to dirt because

- [Air filter](#) clogged.
- [Exhaust port](#) and [transfer ports](#) in [cylinder](#) clogged with carbon.
- Thick carbon deposits in [cylinder head](#).
- [Exhaust pipe](#) and [muffler](#) are dirty.
- Vent on fuel tank cap clogged.
- Spark plug vitrified.

Due to reduced compression because

See "Lack of compression" under *Engine does not start*

Other Engine Troubles

Irregular running because

- Ignition cables loose or damaged.
- Engine gets too hot, causing fuel vapor bubbles to interrupt fuel supply.
- Contact breaker [points](#) oiled or burnt.
- Supporting pin for contact breaker arm worn.
- Spark plug or connector or ignition armature defective.

Engine four-strokes and does not accelerate because

- [Carburetor](#) flooded due to dirty or worn needle.
- [Float](#) is leaking.
- [Exhaust port](#) is clogged with carbon.
- Carburetor not correctly adjusted or [jet](#) loose.
- [Air filter](#) dirty.

Engine knocks while running at full throttle under load because

- Too much engine advance.
- Excessive carbon deposit in the [combustion chamber](#).
- Cooling fins dirty.

Engine backfires or spits into carburetor because

- Engine does not get sufficient fuel.
- [Spark plug](#) glowing due to wrong heat value.
- Spark plug bridged, dirty, or vitrified.
- Engine getting wrong [fuel/air mixture](#).
- Glow ignitions.

Engine does not idle because

- [Idle screw](#) incorrectly set.
- Control cable for throttle valve incorrectly set.
- Ignition armature damaged.

Engine consumes too much fuel because

- Gas tank, fuel valve/petcock, or carburetor leaking.
- Jet needle or needle jet too worn.
- [Jets](#) too large.

Engine does not accelerate smoothly because

- Low engine power (see above somewhere).
- [Clutch](#) plates worn.
- Clutch plates glazed due to overheating by two people riding moped, too high idle speed, insufficient or wrong type of [Transmission fluid](#) used.

Lecture Hour 9: Two Wheeler Maintenance and Servicing:

It is often seen that people are seeking newer vehicles that would give them ultimate comfortable ride and would serve the purposes needed. It is quite a common sight that a significant number of two wheeler owners neglect proper maintenance of their vehicles resulting in their longevity getting affected. No wonder almost all the two wheeler companies in India have come up with their automobile service centers throughout the country. These service centers play a vital role in the effective servicing of your favorite two wheeler.

With proper maintenance of your vehicle you can certainly reduce the servicing cost that you might have to incur at a later stage.

Following through some of the simple to follow maintenance tips, one can ensure better and optimal and fuel-efficient performance of the two wheeler.

It has been seen that with the relevant maintenance tips for the two wheelers you can significantly retain their level of performance. By following the various maintenance tips provided by automobileindia.com you will be able to increase the efficiency of the vehicles. To keep your vehicles in a very good shape it is quite necessary that you regularly keep changing the oil. It is also important that you keep notice of the condition of the tires, working of the batteries and also the functioning of the electrical system of the automobile. A healthy electrical system and a well charged battery ensures quick start of your vehicle, without any trouble.

There are a number of measures that you can take to ascertain the longevity of your automobile. While driving your vehicle if some strange sound occurs then that would require immediate attention. Problems could be with the wheels, fan belt, engine and various other internal parts of the vehicle. Some of the popular maintenance tips associated with the care of two wheelers are as follows:

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With proper maintenance of your vehicle you can certainly reduce the servicing cost that you might have to incur at a later stage.

Following through some of the simple to follow maintenance tips, one can ensure better and optimal and fuel-efficient performance of the two wheeler.

It has been seen that with the relevant maintenance tips for the two wheelers you can significantly retain their level of performance. By following the various maintenance tips provided by automobileindia.com you will be able to increase the efficiency of the vehicles. To keep your vehicles in a very good shape it is quite necessary that you regularly keep changing the oil. It is also important that you keep notice of the condition of the tires, working of the batteries and also the functioning of the electrical system of the automobile. A healthy electrical system and a well charged battery ensures quick start of your vehicle, without any trouble.

There are a number of measures that you can take to ascertain the longevity of your automobile. While driving your vehicle if some strange sound occurs then that would require immediate attention. Problems could be with the wheels, fan belt, engine and various other internal parts of the vehicle. Some of the popular maintenance tips associated with the care of two wheelers are as follows:

In case of a front brake, one should ensure if the free play and brake fluid levels are fine.

- Rear Brake Pedal should be regularly checked and ensured that it is free of any trouble.
- In case of low tire pressure, it should be inflated as per the specifications while in case of more, that should be deflated. Free movement of tire should also be ensured and in case of any trouble on that account, the service center or mechanics should be consulted.
- Odour of fuel will indicate a fuel leakage problem and that should be consulted with the service center immediately.
- A starting trouble will indicate insufficient fuel and then fuel should be filled in.
- If horn, lights and fuel gauge are troubling, the two wheeler should be taken to the concerned service center and should be serviced accordingly.
- In addition to, proper upkeep and periodical servicing while following the guidelines diligently will ensure that the two wheeler remains in a great condition and comes up with optimal performance.
- In case of a front brake, one should ensure if the free play and brake fluid levels are fine.
- Rear Brake Pedal should be regularly checked and ensured that it is free of any trouble.
- Odor of fuel will indicate a fuel leakage problem and that should be consulted with the service center immediately.

- A starting trouble will indicate insufficient fuel and then fuel should be filled in.
- If horn, lights and fuel gauge are troubling, the two-wheeler should be taken to the concerned service center and should be serviced accordingly.

Unit V : Three Wheelers

Lecture Hour 1: Introduction to Auto Rickshaw, Pickup van, Delivery van



Lecture Hour 2 : Technical specification of Auto Rickshaw

Bajaj Auto Rickshaw

This type of auto rickshaw is in great use for commercial transportation. Specially designed for better performance the vehicle is entitled with durability, good looks and fuel efficiency.

Technical specifications :

	Engine
Type	2 Stroke
Cooling Type	Forced Air Cooled
Displacement	145.45 cc

Max Power	7 bhp(5.15 kW) @ 5000 rpm
Max Torque	12.1 Nm @ 3500 rpm
Ignition Type	CDI
Transmission Type	4 forward and one reverse
Clutch Type	Wet multidisc type

Electrical System

System	12V AC + DC
Head Light	35/35W
Horn	12 V AC

Chassis

Chassis Type	Monocoque
Maximum Payload	333 kg

Suspension

Front Suspension	Helical spring and hydraulic shock absorber with antidive link
Rear Suspension	Independent suspension with spring and hydraulic shock absorber

Tyres

Front Tyre Size	4.00-8, 4PR
Rear Tyre Size	4.00-8, 4PR 2 Nos.

Brakes

Front Brakes	Drum Hydraulic
Rear Brakes	Drum Hydraulic

Lecture Hour 3: Technical Specification of Pick up Van FORD SUPER DUTY PICKUP Specifications

Fuel Capacity	35 gallons (6.2L V8 gas engine) 26 gallons (6.7L Power Stroke™ Turbo Diesel and 156" wheelbases) 37.5 gallons (6.7L Power Stroke™ Turbo Diesel 172" wheelbases)
Drive Type	4x2 4x4
Available Engines	6.2L V8 Gas (FFV) 6.7L Power Stroke® V8 Turbo Diesel
Horsepower	385 @ 5500 rpm (6.2L V8 under 10K GVWR) (6.2L V8 over 10K GVWR) 400 @ 2800 rpm (6.7L Power Stroke™ Turbo Diesel)

Torque	405 @ 4500 rpm (6.2L V8 under 10K GVWR) (6.2L V8 over 10K GVWR)
Transmission	800 @ 1600 rpm (6.7L Power Stroke™ Turbo Diesel) TorqShift® 6-speed SelectShift Automatic™
Wheelbase	137.0" (Regular Cab) 141.8" (SWB SuperCab); 158.0" (LWB SuperCab) 156.2" (SWB Crew Cab); 172.4" (LWB Crew Cab)
Maximum Conventional Towing	18,500 lbs. (F-350 Crew Cab DRW 4x2 and 4x4 with 6.7L Power Stroke™ Turbo Diesel)
Maximum Payload	7,260 lbs. (F-350 DRW 4x2 Regular Cab)
Maximum GVWR	14,000 lbs.
Warranty	Bumper to Bumper: 3 years / 36,000 miles Powertrain: 5 years / 60,000 miles Safety Restraint System: 5 years / 60,000 miles Corrosion (Perforation only): 5 years / Unlimited miles Roadside Assistance Program: 5 years / 60,000 miles

Lecture Hour 4: Technical Specifications of Delivery van

Bajaj GC Max 1000

We dealing in Bajaj GC 1000 pick up which is widely accepted for its convenience in the cargo carrier segment. The vehicle has very high efficiency and capable of taking great loads in the commercial goods transportation.

Technical specifications :

Engine	
Type	Four Stroke, Single Cylinder, IDI, Compression Ignition
Cooling Type	Forced Air Cooled
Displacement	416 cc
Max Power	8.5 bhp(6.25 kW) @ 3600 rpm
Max Torque	20 Nm @ 2400 rpm
Ignition Type	Electric start
Transmission Type	4 forward & 1 reverse gear
Clutch Type	Single plate,dry friction type,foot operated
Electrical System	
System	System 12V DC
Chassis	
Chassis Type	Semi Monocoque
Suspension	

Front Suspension	Antidive leading link with helical compression spring & shock absorber
Rear Suspension	Independent suspension with spring & shock absorber

Tyres

Front Tyre Size	Front Tyre Size
Rear Tyre Size	4.5x10,8PR

Brakes

Front Brakes	Hydraulic brakes with auto adjuster
Rear Brakes	Hydraulic brakes with auto adjuster

Lecture Hour 5: MAINTENANCE

There's not much to maintain on a day-to-day basis on most modern 3WMCs, but do what you can do, including your pre-ride checks.

Your bike has a regular service schedule listed in the owner's manual. Unless you are an accomplished mechanic, we recommend that these services be done by an authorized dealer. Keeping your 3WMC clean is a good idea. It's astounding how dirt can cover up something that is about to go wrong.

Check your battery every month. Make sure the fluid level is where it should be. If it is low, top it up with distilled water.

Always take your tool kit along when you go for a ride.

You never can tell when it will come in handy. Use the tools to go over the bike occasionally and make sure no screws or bolts are loose

You should always have your owner's manual with the bike. It tells you where the fuse box is, in the unlikely chance a fuse blows. It tells you how to remove a wheel, should you have the misfortune of a flat tire.

Flat tires are pretty rare occurrences on 3WMCs, but they can happen. In this case, you can either get on the phone to the dealer, or fix it yourself. If you want to know how to do it, we recommend you practice at home, rather than have your first shot at fixing a flat alongside a deserted road in the middle of the night.

Lecture Hour 6: Trouble Shooting

#1

If the engine doesn't start:

Is the key on?

Is there gas?

Is the battery too weak?

Or a battery connection loose?

Have spark plug wires fallen off?
Is the ignition cut-off switch in the OFF position?
Do you have the choke in the appropriate position?

#2

If the engine stops when you don't want it to:
Did you hit the cut-off switch by mistake?
Did you run out of gas?
Did a fuse burn out?

#3

Odd Steering

If the bike begins to feel funny as you go down the road, especially in a curve, stop as soon as it is safe to pull over and check your tires. You may have a flat. Check your suspension. You may have it adjusted incorrectly. Your owner's manual is the best reference for proper settings and adjustments.

#4

Poor Response

If you detect any problems with the 3WMC – doesn't feel right, doesn't handle right, doesn't sound right – that you can't figure out yourself, take it to your dealer. Think about the problem a little so you can describe it to the service manager. Remember, an ounce of prevention is worth about a ton of cure.

Lecture Hour 7: Equipment Failures

BLOWOUTS

If you run tires of good quality, keep them at the proper pressure, and change them when the tread is worn, the chances of having a blowout are small. However, you must act quickly if it happens to you.

#1

Do not use the brakes; braking hard will only make things worse. If you must use some brake, apply gradual pressure to the brake on the good tire(s) and ease over to a safe spot to stop.

#2

Ease off on the throttle and slow down gradually; rapid deceleration could throw the bike out of control.

#3

Hold those handlebars firmly; a great shuddering may take place as the out-of-round tire flops against the pavement, but you are concerned only with keeping the front wheel(s) pointed where you want to go until you stop.

STUCK THROTTLE

Most riders have had bad dreams about this, but few have experienced the problem. That is why all contemporary motorcycles have a cut-off switch by the right thumb. Just in case. Practice using the cut-off switch. Chances are you will never have a throttle stick, but if you do, you'll know how

to deal with it.

As you hit the cut-off switch, squeeze the clutch (you will probably be in gear); then look for a safe place to coast to a stop

BROKEN CLUTCH CABLE

Imagine you are cruising along in fifth gear; you want to shift down; you squeeze the clutch lever - and there is no return action. It just lies up against the handgrip. No fun, but not dangerous. You can shift the bike without using the clutch lever. This is not advisable unless necessary, but it can be done. Back off on the throttle and shift down a gear.

If you have a sensitive foot, you can probably find neutral before coming to a complete stop. If not, get set for a jerky halt.

Lecture Hour 8: Fault Tracing of Three wheeler

Failure to Start

If your Morgan won't start, check the following:

1. Do you have sufficient fuel in the tank?
2. Is the engine immobiliser disabled correctly?
3. Is the battery fully charged?

Battery Condition

99% of all starting problems are electrical, and most of those are down to insufficient power being available from the battery to start the engine. On newer cars with ECUs, if the battery isn't delivering sufficient voltage (usually at least 10V whilst cranking, 13.2V at rest, 14.4V whilst idling) then the ECU won't allow the car to start, likewise if the starter can't crank the engine at sufficient revs (around 100-130 rpm).

If you don't use your car much, especially in winter, it is a good idea to keep the battery hooked up to a conditioner.

Starter Motors

A quick test with newer cars with ECU's and "pre engage" starter motors (e.g. Zetec's) is to try to "bump start" them. If they fire up with no problems the "pre engage" starter motor needs to be looked at before determining the battery has a low voltage fault and starving the ECU of power.

(Notes for Zetec-engined cars: All too common a fault with the Zetec's and an owner can end up paying for a new battery AND a new starter motor. The FORD starter motors can develop "dry joints" which give the same fault that you have described, NB battery Volts drop right off when you try to start. A good mechanic can re-solder the dry joints as the cheapest repair solution. I have had this happen to me on my way to Le Mans Classic and resolved when I returned home days later and a good few bump starts. I still have the same Red Flash

Battery and same starter motor 5 years on and they are working OK.)

Fuses

Make sure you know where all the fuses and relays are on your car, and which ones will prevent the car from starting if they are blown

Wiring

If your battery is in good condition, the next check is the wiring. There is a main power cable that runs from the battery direct to the starter motor. Ensure this is in good condition. Similarly, check the earth strap from the battery to the chassis, and don't forget to check the strap that goes from the engine to the chassis, too.

If you are not familiar with the layout for your car, DON'T wait until it fails to start before trying to figure out what goes where. One warm sunny Sunday afternoon, grab yourself a cup of tea, and pretend that your car won't start. Locate and identify all the main components, and reassure yourself you know what 'good' looks like. This makes it much easier on a dark afternoon in November when the starter cable has come adrift from the starter motor and you are trying to remember where it's supposed to go.

Fuses

Make sure you know where all the fuses and Failure to Start

If your Morgan won't start, check the following:

1. Do you have sufficient fuel in the tank?
2. Is the engine immobiliser disabled correctly?
3. Is the battery fully charged?

Lecture Hour 9: Service Schedule of Three wheeler ignition system

1. COIL <u>1.01 Ballast Resistor Watchpoint</u> <u>1.02 Bosch Blue Coils Warning</u> <u>1.03 Checking Your</u> <u>1.04 Coding Letters C.B. and S.W.</u> <u>1.05 Early Lucas</u> (Trouble-shooting them Pages 15-25)	<u>3.02 Key Assembly</u> (for some LHDs) <u>3.03 Switches</u> (1970s - early 1980s) <u>4. PLUS 8 SPECIFIC</u> 5. SPARK PLUGS <u>5.01 Anti-Seize</u> <u>5.02 Appearance</u> <u>5.03 Champion Cross-Reference</u> <u>5.04 Champion Part Numbers</u> <u>5.05 Installing and Removing Them</u> <u>5.06 NGK Part Numbers</u> <u>5.07 NGK Cross-Reference</u> <u>5.08 Plus 4 (Triumph)</u>	<u>5.09 PRIMER</u> <u>5.10 Torque</u> 6. STARTER <u>6.01 Checking</u> <u>6.02 Diagnosis</u> 7. TROUBLESHOOTING 7.01 Coil 7.02 Ignition 7.03 4/4 immobilizer 7.04 Plus 8 Immobilizer 7.05 Starter 7.06 Tachometer
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